LABORATORY GUIDE TO HEALTH

BLOUNT

LABORATORY GUIDE

AND

PUPIL'S NOTE-BOOK

FOR THE STUDY OF

HEALTH

BY

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BOSTON NEW YORK CHICAGO

ATLANTA SAN FRANCISCO

PREFACE

As the pupil comes to each exercise in this note-book he should get clearly in mind the problem which he is to solve by working out that exercise. He should make the problem really his problem. He should keep it constantly before him as he works through the entire exercise and insist on having a clear solution of it before he calls the work complete.

The questions are a guide to direct the pupil's attention to items worth observing. He has by no means got the full value of the exercise when he has merely written the answers. With his attention on the material before him he must observe details beyond those directly involved in the questions. These he must arrange and classify in a scientific way. Finally he must bring reason and imagination to bear upon the data he gathers, thus putting meaning into them.

The exercises of the note-book should be closely related to the reading text, *Health*. The two books supplement each other and together make a well-balanced unit, the practical work of the note-book supplying visual concreteness, the reading text providing explanation and making the significance and value clear.

As the pupil works he should keep in mind three virtues of a note-book; neatness, completeness, and

accuracy. The careful teacher will take all three into account as he grades the books.

To secure neatness the pupil should write with pen and ink, keeping the margin wide and even. If he wishes to write more than the space allows, he should insert an extra sheet of paper between the pages of the book. Drawings may be made carefully with a medium hard, sharp pencil. Every line should be clear and should have a significance — no indistinct general effects, as is perhaps permissible in art work.

The pupil should aim not only to see the object of study as it really is (by no means an easy accomplishment), but in making his record he should choose carefully the terms of expression which give his thought precisely.

A well-kept note-book is a thing for a pupil to be proud of, something to show as an evidence of the good work he has done. It may well be embellished by clippings, sketches, cartoons, and photographs which relate to any of the exercises or to corresponding topics in *Health*.

R. E. B.

CONTENTS

Red phosphorus.

Mercury (quicksilver).

Sulfur.

Calcium.

Carbon (charcoal, lampblack, graphite, etc.).

SYNTHESIS OF ELEMENTS

(*A*) Iron Sulfid

Problem: What may happen when two elements are brought together and heated?

Material: A teaspoonful of iron filings, a spoonful of powdered sulfur, test tube and holder, burner, magnet.

Touch the iron filings with the magnet.

1. *What happens?*

Mix the iron with the sulfur, touch the mixture with the magnet, and lift the magnet.

2. *Has the iron changed by mixing with the sulfur?*

Mix the two elements again and heat the mixture in a test tube until it is glowing red. Let it cool. Break the test tube and try the contents with the magnet.

3. *Is the iron changed when the mixture of iron and sulfur is heated?*

The iron and sulfur have combined to produce the compound *iron sulfid.*

4. *In what particulars does the compound differ from the elements of which it is composed?*

(*B*) Zinc Sulfid

Problem: How can we produce a compound from two elements?

Material: A spoonful of zinc dust, a spoonful of sulfur, a brick, a burner.

Mix the zinc dust and sulfur on the brick.

1. *Is there any evidence that the elements have changed?*

Apply the flame of the burner. (*Caution!* Keep back out of the flare.)

2. *What influence made the elements combine?*

3. *How is the compound, zinc sulfid, different from the mixture or from the elements of which it is composed?*

DISINTEGRATION OF A COMPOUND

Problem: How can we break up a compound into the elements of which it is composed?

Material: Red oxid of mercury, test tube and holder, burner, splinters of wood.

1. *Describe the powder, (a) color.*

(b) weight.

Place in the test tube enough mercuric oxid to cover the bottom, and heat strongly. While heating insert into the tube the end of the splinter red hot but not blazing. (Wood burns as oxygen combines with it.)

2. *What evidence is there that there is more oxygen in the tube than in the air?*

3. *Where could the oxygen have come from?*

When the powder has disappeared, look on the side of the tube and shake out into your hand some of the mercury you see there.

4. *How did the mercury get on the side of the tube?*

5. *Conclusion — Of what two elements is the orange-colored powder composed?*

6. *What force was used in making the oxygen separate from the mercury?*

OXYGEN

Problem: How can we get pure oxygen, and what will it do?

Material: A piece of oxone (sodium peroxid fused) the size of a Brazil nut, wide-mouthed generating bottle with a rubber tube through stopper, a trough, and two collecting bottles about one pint each, picture wire, splinter, burner.

Fill the collecting bottles with water and invert them on the shelf of the trough. Put water into the generating bottle, about two inches deep, and drop into it the piece of oxone. As soon as the bubbles appear stopper the bottle and hold the tube from the stopper under a collecting bottle. When all the water has been forced out of the collecting bottles, cover each with a glass plate and stand it upright on the table.

1. *What comes from the generating bottle and displaces the water in the collecting bottle?*

Light a splinter and when it is burning well blow out the blaze and thrust the red coal into one bottle of the gas collected (oxygen).

2. *What happens to the glowing splinter?*

Heat an end of the picture wire red hot in the burner and thrust it into the other bottle of oxygen, replacing the cover. If it does not work readily, fasten a bit of kindling (a half match, a little sulfur or steel wool) to the end of the wire before heating.

3. *What do you see?*

4. *If you can find particles of burned iron, iron oxid, on the cover or on the sides of the bottle give their color.*

In these experiments you have two examples of oxidation.

5. *What occurs in oxidation?*

HYDROGEN

Problem: How can we get hydrogen, and what properties has it?

Material: A piece of hydrone (calcium hydrid) the size of a Brazil nut, a generating bottle with a tube through the stopper, a trough and three collecting bottles, a splinter.

Invert the three collecting bottles full of water in the trough. Put two inches of water into the generating bottle, drop in the hydrone, and replace the stopper. As soon as the air is driven out of the generator collect the hydrogen in the three bottles. Let them stand inverted in the trough.

1. *What goes from the generating bottle into the collecting bottles?*

Light the splinter and while it is blazing thrust it up into a bottle which you raise inverted from the trough.

2. *What happens to the blaze?*

3. *Will a fire burn when surrounded by hydrogen?*

4. *What happens at the mouth of the bottle?*

5. *Will hydrogen in contact with air burn when a flame is applied?*

Cover the other two bottles with glass plates and stand them upright on the table. Hold a lighted splinter six inches above a bottle and remove the cover plate.

6. *What happens?*

Remove the cover from the remaining bottle and after five seconds bring the lighted splinter to the mouth of the bottle.

7. *Why is the result different from that of the preceding experiment?*

8. *In what ways is hydrogen different from oxygen?*

NITROGEN

Problem: How can we get nitrogen by itself, and what properties has it?

Material: Pyrogallic acid (photographic developer), potassium hydroxid, a pan nearly full of water, a test tube 6 by $\frac{3}{4}$ inches, a splinter, a ruler. Note: Air is composed chiefly of nitrogen and oxygen.

Put into the test tube pyrogallic acid to the quantity of a lima bean, add a spoonful of strong potassium hydroxid, and water to the depth of one inch from the bottom of the tube. Cover the tube with the thumb and hold it shut.

1. *How many inches of air are in the tube?*

Shake the tube till the acid has absorbed all the oxygen, a minute or two. (Note that the thumb is sucked in.) Hold the hand and tube under water in the pan, the bottom of the tube higher than the mouth. Carefully open the tube a little to let water in to take the place of the oxygen absorbed, then close it, and hold it right side up.

2. *How many inches of nitrogen are in the tube above the liquid?*

3. *What fraction of the atmosphere is nitrogen?*

Light a splinter and thrust it into the nitrogen.

4. *What happens to the blaze?*

5. *How does nitrogen differ in its properties*

   (*a*) *from oxygen?*

   (*b*) *from hydrogen?*

CARBON DIOXID

Problem: How can we get carbon dioxid, and what are its properties?

Material: Dilute hydrochloric acid, marble chips, a generating bottle, three collecting bottles, a trough, a splinter, limewater.

Fill the collecting bottles with water and invert them in the trough. Put the marble chips in the generating bottle and pour over them the acid. Collect the gas which arises. Cover the three bottles and stand them on the table. Hold the end of the tube from the generating bottle in a small glass of limewater for a few seconds.

1. *What change occurs in the appearance of the limewater?*

Blow through a tube or straw into another glass of limewater.

2. *What is the result?*

3. *What do you infer is in your breath?*

Light a splinter and thrust it blazing into one of the bottles of gas.

4. *What does carbon dioxid do to a fire immersed in it?*

Take the cover off another bottle and let it stand a few minutes, then try it with the blazing splinter. Try again after several minutes and again if necessary till the splinter continues to burn. Get a *small* flame on the splinter or on a match and, holding the third bottle of gas three or four inches above it, pour over it the carbon dioxid.

5. *What do these experiments prove about the weight of carbon dioxid?*

6. *How does carbon dioxid differ in its properties* (*a*) *from nitrogen?*

(*b*) *from hydrogen?*

(*c*) *from oxygen?*

See HEALTH, page 236, fire extinguishers.

STUDIES OF CELLS

Problem: How do cells appear when magnified?

Material: A small piece of onion, water, glass slide, lens (linen tester), compound microscope or projector, dilute iodin.

Put a drop of water in the middle of the slide. Strip the thin skin (epidermis) from the inner (concave) side of the piece of onion and lay it flat in the drop of water. Cover the onion skin with water. Open the lens fully and examine the onion skin with it. In using the lens observe the following:

1. *Focus.* The object examined must be at a certain distance, called *focal distance,* from the lens. To get the distance with the linen tester place the object in the opening in the foot of the standard, the glass of the lens held close to the eye.
2. *Light.* Transmitted light shines through the object, reflected light strikes the surface of the object and reflects to the eye. Usually one light will bring out some points not shown by the other. Use one light then the other. To get transmitted light hold the object up and look through it toward the window or some diffused artificial light. To get reflected light hold the object down with a dark background and a good diffuse light shining on its upper surface. Be sure your fingers or the standard of the lens do not get in the way of the light.
3. Hold the object steady, up to the eye; do not bend down to the desk.

1. *Sketch a few onion skin cells, seen with a hand lens.*

2. *Sketch a few onion skin cells, seen under the compound microscope or thrown on the screen with a projector. Label nucleus and wall.*

3. *Make short notes on other cells shown in demonstration.*

EXAMPLES OF TISSUES

Problem: How do various tissues and their characteristics compare with one another?

NOTE: The tissues (except bone) in the live animal were soft, but became stiff at death.

Write two or three distinguishing features you observe about each specimen.

1. Bone.

2. Liver.

3. Fat (suet).

4. Brain.

5. Muscle.

6. Kidney.

7. Skin.

FRAMEWORK OF THE BODY

Problem: How may we become familiar with the structure and plan of the framework of the body?

(*A*) General Study

Material: A mounted skeleton, a separate 1st vertebra and 2nd vertebra, Figure 8, Page 15, HEALTH.

1. *Of how many vertebrae is the axis of the body composed?*

2. *Divide the vertebrae into three groups, and tell how to designate each group.*

3. *Why need the lumbar vertebrae be so much larger than the neck vertebrae?*

4. *With separate bones demonstrate the rotation of the first vertebra on the second. Which would you call the axis?*

5. *How many pairs of ribs are there?*

6. *To what are the ribs attached*
   (*a*) *dorsally?*

   (*b*) *ventrally?*

7. *Which ribs are more movable in their attachment?*

Note that the collar bone and shoulder blade together make an incomplete ring (shoulder girdle), and the bones at the hips a complete ring.

8. *Why need the pelvic girdle be stronger than the shoulder girdle?*

From these girdles the two pairs of limbs are appended.

9. *Write the names of homologous (corresponding) bones opposite each other.*

Bones of the Upper Limb	Bones of the Lower Limb

(*B*) Separate Bones

Material: A skeleton, separate bones to be taken to the pupil's desk.

Arm or Leg Bones.

1. *Give reasons why the ends need be larger than the shaft (middle).*

2. *Find raised places or depressions where tendons or muscles were attached and describe the surface.*

3. *Compare the surface at a joint with this surface.*

Vertebrae. Note the main part (body or centrum) which supports the weight, and the dorsal arch which protects the spinal cord.

4. *Name as many uses as you can find for the projections from the arch.*

5. *In the mounted skeleton find the side openings through which the nerves and blood vessels enter or leave the spinal canal, and give their situation.*

Pelvis. Somewhat bowl shaped, it is open at the bottom to admit the passage of the bowel.

6. *Where are conspicuous rough places for the attachment of muscles?*

7. *How many vertebrae are grown together to form the sacrum?*

8. *Of what use are the deep sockets in the hip bones?*

Shoulder Blade

9. *Is your own firmly or movably (by means of muscles) fastened to the ribs?*

10. *Give two or three uses for the high crest on the dorsal side of the shoulder blade.*

11. *Find the place where the humerus joins the shoulder blade and describe the surface.*

Skull. Note the two groups of bones composing the skull — the cranium and the facial bones.

12. *What is the use of the cranium?*

13. *Describe its sutures (seams) and sketch about half an inch of one.*

14. *Where is the opening through which the spinal cord passes?*

15. *Where are a number of small openings for the passage of blood vessels and nerves?*

16. *If the turbinate bones (which are easily broken out) are still in the nasal cavity, does their presence make the nasal surface greater or less than their absence would make it?*

17. *Is the upper jaw firmly or movably fastened to the other bones?*

18. *Does the lower jaw hinge in front of, or behind the ears?*

19. *Is the firmness of the teeth due to their being set in bone or in the gums only?*

(*C*) The Composition of Bone

Material: A piece of bone in a bottle of dilute hydrochloric acid, a thoroughly decalcified bone, a bone burned to whiteness.

1. *What arises in the acid?* (See note-book, page 13.)

2. *What material do you infer may be in the bone?*

Observe the flexibility of the bone after it is thoroughly decalcified.

3. *What function has the mineral which has been removed from the bone?*

4. *What substance did the fire remove from the burnt bone?*

5. *How is the burnt bone different from a fresh bone in its resistance to blows?*

6. *What function does the gristly substance of the bone have?*

(*D*) Bone Structure

Material: A compound microscope, a piece of bone ground to the thinness of paper and mounted on a glass slide.

Sketch a section of bone seen under the compound microscope.

A STUDY OF TENDONS

Problem: What is the nature and the function of tendons?

Material: A fowl's foot and leg, sheep or veal shanks.

Find the tendons in the fowl's leg and pull one to bend the toes and another to extend them — as muscles would pull.

1. *Where were the muscles that worked these tendons?*

2. *Discuss the value of that situation.* (HEALTH, page 17.)

3. *When you pull on a tendon does it stretch like rubber?*

Try to split a tendon into small strips.

4. *What use could primitive people make of such strips?*

5. *Where can you find tendons in your own body?*
   (*a*)

   (*b*)

   (*c*)

6. *Where is the muscle which works each of them?*
   (*a*)

   (*b*)

   (*c*)

A STUDY OF MUSCLES

Problem: What is the structure of muscles and where are they situated?

(*A*) Examination of Specimens of Muscle

Material: A small piece of lean meat containing a little tendonous tissue, a piece of stomach or intestine wall, a piece of heart, a compound microscope, and glass slide.

1. *Into fibers of how small a diameter can you tear a piece of muscle with your finger nails or with pins?*

2. *What color is the tendonous connective tissue to which muscle fibers fasten?*

3. *Describe the membrane which covers the muscle.*

4. *Sketch a piece of muscle seen with the microscope.*

5. *How different from this muscle is that in the wall of the stomach or intestine or heart?*

(*B*) The Pupil's Own Muscles

Place your right hand on your left upper arm.

1. *How does the muscle you feel change in length, in thickness, and in hardness as you bend the arm at the elbow?*

2. *As you straighten the left arm where do you find muscles undergoing the same changes?*

3. *Where do you find muscles undergoing such changes when you*

   (*a*) *bend the fingers?*

   (*b*) *straighten the fingers?*

   (*c*) *bend the wrist?*

   (*d*) *straighten the wrist?*

   (*e*) *while standing rise on the toes?*

   (*f*) *lift the toes, standing on the heel?*

   (*g*) *bend the leg at the knee?*

   (*h*) *straighten the knee?*

   (*i*) *with the elbow on the desk and the forehead on the hand press down with the head?*

   (*k*) *clench the teeth and bite hard?*

GASTRIC GLANDS

Problem: By what structure is the gastric juice produced?

Material: Preserved specimens of stomach wall, hand lens, compound microscope.

1. *Describe the appearance of the mucous membrane seen with the hand lens.*

2. *How different is the surface seen with the compound microscope?*

3. *How thick is the mucous membrane?* (*Compare with some familiar object.*)

A STUDY OF THE LUNGS

Problem: How can we learn the structure of the respiratory organ?

Material: A pair of sheep's lungs with a small piece of diaphragm attached, a test tube with the bottom broken out, a glass of water.

Press the finger against the lung, then release the pressure.

1. *What shows that the lung is elastic?*

Insert the test tube (after washing it) into the trachea and inflate the lungs by blowing into it.

2. *Compare the size with that of the collapsed lungs.*

3. *Why do the lungs collapse when the inflating stops?*

Snip off a piece of lung and drop it into a glass of water.

4. *Why does it float?*

Compress the trachea and notice how it "gives" where the cartilaginous rings are incomplete.

5. *On which side are the rings incomplete?*

6. *Are the rings of the bronchial tubes complete or incomplete?*

7. *Would this condition keep the rings always one size, or would it allow a change in diameter?*

8. *Compare the mucous membrane lining the trachea and bronchial tubes with the serous membrane (pleura) which covers the lungs.*

9. *What two kinds of tissue do you see in the diaphragm?*

THE BLOOD

Problem: How do blood corpuscles appear and move?

Material: A microscope with $\frac{1}{8}$ inch objective, a microscope with $\frac{1}{2}$ inch objective, blank slides and covers, one per cent acetic acid, methyl blue stain, tadpole, chloretone, absorbent cotton, alcohol, surgeon's needle.

To prepare the blood slide, sponge the lobe of the ear with alcohol; prick it with a surgeon's needle or with the point of a knife blade disinfected. If it does not bleed readily squeeze it a little. Get a drop of blood in the middle of a slide and place a cover glass over it. Under the microscope find a spot where the blood is spread out so that individual cells can be seen.

1. *Sketch a single red corpuscle, $\frac{1}{8}$ inch objective,*
   (a) flat view. *(b) edge view.*

Note that the red color appears where the cells are massed, not in single cells.

The red corpuscles are so numerous that the white can not easily be seen. To render the red cells almost invisible, mix with another drop of blood a drop of one per cent acetic acid in which a weak methyl blue stain is dissolved. The white cells stained blue will be the conspicuous things on the slide.

2. *Sketch two or three white corpuscles, showing the size in proportion to the red, and bringing out the nucleus, $\frac{1}{8}$ inch objective.*

Lay a tadpole on a large slide and cover it, except the end of the tail, with wet absorbent cotton. (A salamander tadpole can be kept in a few drops of water in a hollow ground slide without cover.) As often as the animal flops off put it back. If it does not quiet down reasonably in a few minutes put a few drops of chloretone in its mouth — usually this is unnecessary. Under the microscope ($\frac{1}{2}$ inch objective) find a place in the tadpole's tail where the pigment spots are not too thick and where the blood vessels can easily be seen.

3. *Describe the moving streams of red corpuscles in the capillaries and small veins and arteries,*

(*a*) *rate, steady or irregular.*

(*b*) *single file or many abreast.*

(*c*) *Sketch map showing arrangement of capillaries.*

MICRO-ORGANISMS

Problem: How may we grow and study bacteria, yeast, and molds?

Scrub clean a potato about as large as an egg. If it is to be brought to school wrap it in several folds of muslin. Boil it for fifteen minutes and bring it to school still wrapped up. Sterilize a knife blade by boiling it or by passing it through a flame or by dipping it into alcohol. Then unwrap the potato and slice it in two, being careful to let nothing but the sterile blade touch the cut surface of the potato. Touch a drop of water, of milk, or the finger or any object to the fresh surface and put the potato at once under a clean glass, where it can be watched for a few days without being disturbed. Treat the other half of the potato in the same way, inoculating it from some other object. Keep the potatoes warm and observe them every few hours to note the first appearance of growth. If you do the work at home do not wrap the potato but let it stand in the water in which it was boiled until it is cool enough to handle. Then cut and inoculate it.

1. *How many hours after inoculation does the first growth on the potato show?*

2. *Describe its appearance.*

3. *Note the changes it undergoes during three or four days.*

4. *Describe other spots and their changes, — some bacteria and some mold.*

To prepare beef broth jelly boil a pound of lean chopped beef (heart is good) in a quart of water; strain; to the clear broth add a little salt and a quarter of a pound of gelatine; boil fifteen minutes. Pour this boiling solution into test tubes which have been sterilized by boiling or baking, about an inch in each tube. Stopper the tubes with rather loose fitting plugs of absorbent cotton. Next day steam-sterilize the tubes for about an hour and let them cool, half of the number standing straight up and the remainder inclined so that the jelly will set with a long slanting surface.

To inoculate a tube, get bacteria from a potato spot or from some other source on a sterile needle set in a handle; remove the cotton plug from the tube (holding the plug in your fingers so that nothing can touch its inner end); draw the tip of the needle carrying the bacteria over the slanting surface of the jelly; replace the plug. Take a test tube which cooled in an upright position and stab the needle loaded with germs into the jelly. This is to learn whether the germs grow better at the surface or along the stab shut away from the air.

5. *How many hours after inoculation does the bacterial growth appear on the jelly?*

6. *If the jelly is noticeably affected, describe its changes.*

7. *Note any differences between the stab culture and the surface culture.*

For the study of yeast drop a few crumbs from a yeast cake into a glass of clear, sugary liquid such as fruit juice or much diluted syrup.

8. *How long after putting yeast into the culture solution do you first see bubbles arise?*

To examine yeast cells mount some of the sediment on a blank slide, cover, observe with a $\frac{1}{8}$ inch objective.

9. *Sketch a few yeast cells which have buds.*

Touch a needle point to a spot of bacteria, transfer some of the germs to a slide, and examine under the microscope, $\frac{1}{8}$ inch objective. After studying the live organisms for a few minutes run a little dilute iodin under the cover to stain them and make them more clearly visible.

10. *Sketch a few bacteria.*

Mold appears as a white spot, enlarges in a fairly regular circular form, after a few days turning green or becoming cottony with black or orange specks. To avoid air bubbles mold should be mounted first in alcohol immediately followed by water.

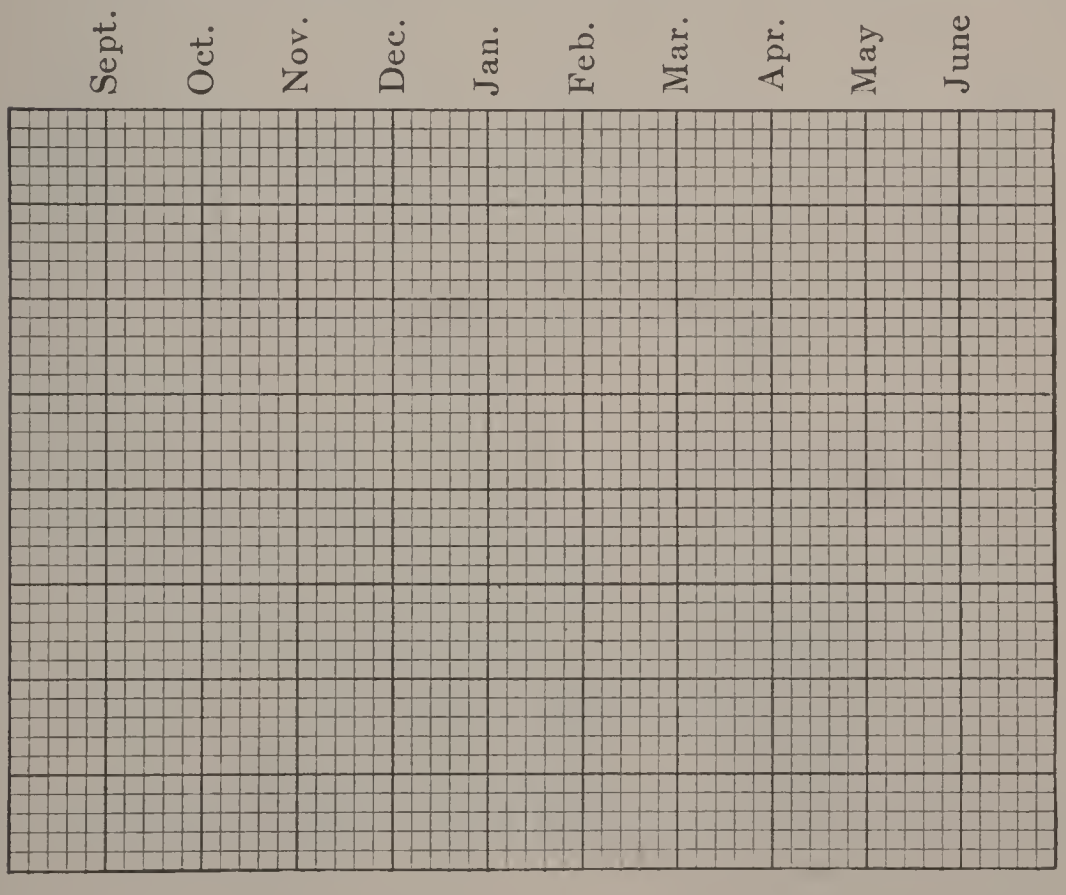
11. *Examine the mold under a $\frac{1}{2}$ inch objective; then sketch under a $\frac{1}{8}$ inch objective*
    (*a*) *a branching thread.* (*b*) *spores.*

HEIGHT–WEIGHT GRAPH

Problem: Is my weight approaching the normal or receding from it?

(*A*) Normal Weight Graph

Find your normal weight. (HEALTH, page 65.) At the left end of the fifth heavy horizontal line from the top in the graph blank below write the first number divisible by five which is above your normal weight. Label the four higher and all the lower heavy lines with their appropriate numbers divisible by five. On the September vertical line make a dot at the height indicated by your normal weight in that month. On each of the



month lines make a dot higher than the preceding by as much as your normal monthly gain. (HEALTH, page 65.) Connect the dots by a line.

(*B*) Actual Weight Graph

In the table on the preceding page, month by month make a dot on the appropriate month line at the height indicated by your actual weight. Connect these dots by a line.

Does your actual graph approach or recede from your normal?

FOOD TESTS

Problem: How may we find the food substances contained in common articles of diet?

Material: Samples of food brought from home, test tube and holder, burner, starch raw and boiled, iodin solution, Haynes solution, nitric acid, ammonia, piece of fat, glucose.

(*A*) Iodin Test for Starch

To prepare the iodin solution dissolve a little potassium iodid in a half ounce of alcohol and add a few flakes of iodin. After they have dissolved dilute with water until the liquid is light brown. Put a drop of the iodin solution on the specimen of boiled starch and another drop on the raw starch.

1. *What effect has iodin on starch?*

In the first column of the table on page 44 write the names of all the food specimens you have brought. Take one fourth of each specimen and apply to it a drop of the iodin solution. If you get the characteristic starch color make a plus mark in the starch column of the table opposite the food. If you do not get the starch color make a minus sign.

(*B*) Grease Spot Test for Fat

Put a drop of water on a piece of writing paper and near it a drop of oil or (warm) fat. Observe the difference between the two spots.

Rub each specimen of food on the paper to see whether it makes a spot. Be careful not to mistake a wet spot for a grease spot. If the food makes a grease spot mark a plus sign in the fat column of the table opposite the name of the food. If it makes no grease spot mark a minus sign in the table.

(*C*) Haynes Solution Test for Sugar

To make Haynes solution (an improvement on the Fehling solution) dissolve 60 grains of copper sulfate in one ounce of water (warm), mix with one ounce of glycerine, add ten ounces of a 5 per cent solution of potassium hydroxid. This will keep for months and can be diluted if desired.

Drop a little glucose into a test tube, add a half inch of Haynes solution, and hold it in the flame of the burner till it boils. Boil common sugar in a little sulfuric acid, then apply the Haynes solution test.

2. *What color change is produced by boiling glucose in Haynes solution?*

Test a portion of each food specimen by boiling it in Haynes solution. Wash out the tube before each test. If you get the characteristic glucose color, mark a plus sign in the sugar column of the table opposite the name of the food. If you do not get the glucose color mark a minus sign in the table. If you think a food contains common sugar, first boil it in sulfuric acid, then test with Haynes solution.

(*D*) Nitric Acid Test for Protein

Put a small piece of lean meat or cheese into the test tube, cover it with nitric acid, hold it in the flame of the burner till it boils. (*Caution!* Do not get nitric acid on your hands or clothes. If you do, put on ammonia at once and wash it off with water.) If the food remains a lump pour off the acid and add ammonia to the contents of the tube to neutralize it — drop in the ammonia until it no longer sputters. If the food dissolves, the whole contents of the tube must be neutralized.

3. *What color is produced in protein food (meat, cheese, etc.) by the nitric acid test?*

Test a portion of each food specimen you have by boiling it in nitric acid and neutralizing with ammonia. If you get the characteristic protein color, mark a plus sign in the table. If you do not get the color, mark a minus sign.

FOOD COMPOSITION

Food	Starch	Fat	Sugar	Protein

TABLE OF FOOD VALUES

(Approximate)

Fill in the last two columns, giving an average current price for each item, and computing the Calories for a cent by dividing the Calories per pound by the price.

Foods as Purchased	Protein Per Cent	Fat Per Cent	Carbo-hydrates Per Cent	Calories per Pound	Price per Pound	Calories for One Cent
Bacon	10	60	0	2400		
Beef, fat	15	20	0	1100		
lean	19	8	0	700		
Fowl	14	12	0	750		
Ham, smoked	17	18	0	1000		
Liver	20	3	2.5	540		
Mutton	14	23	0	1200		
Pork chops	13	24	0	1200		
Salt pork	2	86	0	3500		
Turkey	16	18	0	1000		
Veal	16	6	0	500		
Fish, entire	11	4	0	360		
steak	15	4	0	460		
Oysters	9	2	4	330		
Butter	1	85	0	3500		
Buttermilk	3	1.5	5	160		
Cheese, cream	26	34	2	1900		
Cottage cheese	21	1	4	500		
Eggs	12	9	0	600		
Lard	0	100	0	4000		
Milk, whole	3.3	4	5	300		
Baked beans	7	2	20	600		
Beans, dry	22	2	60	1600		
Boston brown bread	6	6	54	1300		
Corn meal	9	2	75	1600		
Cracked wheat	11	2	75	1600		
Oatmeal	16	7	67	1800		

Foods as Purchased	Protein Per Cent	Fat Per Cent	Carbo-hydrates Per Cent	Calories per Pound	Price per Pound	Calories for One Cent
Rice	8	0	79	1600		
Rye flour	7	1	78	1600		
Wheat flour	11	1	75	1600		
White bread	9	1	53	1100		
Whole wheat flour	14	2	72	1600		
Asparagus	2	.2	3.3	100		
Beets	1	0	8	160		
Cabbage	1.5	0	5	120		
Carrots	1	0	7	160		
Cauliflower	2	.5	5	140		
Green corn	1	.5	8	180		
Green peas	3.5	.2	10	250		
Lettuce	1	0	2.5	70		
Onions	.5	0	9	200		
Potatoes	2	0	15	300		
String beans	2	.3	7	180		
Sweet potatoes	1.5	.5	22	450		
Tomatoes	1	0	4	100		
Apples	.3	.3	11	200		
Bananas	1	.5	14	300		
Grapes	1	1	14	300		
Oranges	1	0	8	170		
Pears	.5	.5	13	260		
Watermelon	.2	0	3	60		
Almonds	11	30	10	1600		
Black walnuts	7	15	·3	780		
Brazil nuts	8	34	3	1600		
Chestnuts	5	4.5	35	900		
English walnuts	5	17	4	860		
Chocolate	13	48	30	2800		
Cocoa	21	29	38	2200		
Prunes	2	0	62	1160		
Raisins	2	3	68	1400		
Sugar	0	0	100	1800		

NET FOOD TABLE

Problem: What per cent of a *net* food is protein, fat, or carbohydrate?

From the table on the preceding page get the per cents of protein, fat, and carbohydrate for lean beef (19, 8, 0), add them together, and divide each per cent by the total. (See HEALTH, page 71.) Write opposite the word "beef" in the table below the quotients you get by dividing the per cent items by the total. In this way compute the net per cents for each food named in the table.

FOOD	PROTEIN	FAT	CARBOHYDRATES
Beef, lean			
Fowl			
Pork chops			
Oatmeal			
Corn meal			
Cracked wheat			
Rice			
Potatoes			
Grapes			
English walnuts			
Dry beans			

DINNER

Problem: How much energy does a dinner supply and how much does it cost?

Make out a bill of fare for a dinner (using items in the table on pages 45 and 46) in which about $\frac{1}{8}$ of the food shall be protein and the total Calories about 1500 for each person. Compute the cost.

Items	Calories	Cost
Total		

MARKET SCORE CARD

Problem: How do our markets rank in their sanitary qualities?

Write in the last column the figures 2, 1, or 0 as the market is excellent, fair, or poor. Compute the total score. Compare this market with other markets reported by other pupils.

NAME OF MARKET..... .....DATE

ITEMS	EXCELLENT (2)	FAIR (1)	POOR (0)	SCORE
Light	good everywhere	some places indistinct	considerable obscurity	
Odor	only fresh odors	bad odors barely smelled	conspicuous odors of food spoiled	
Flies	none	few	many	
Food protected	from customer's hands and from flies and dust	slightly, not perfectly	exposed to handling, flies, and dust	
Clerk	clean person clean apron	hands not clean, or apron soiled	dirty and slovenly	
General tidiness and cleanliness	floor swept, furniture dusted, goods in order, repairs kept up	an atmosphere of letting down in care	scraps on floor, dust on counters, things upset	
			Total score	

STUDY OF THE MOUTH

Problem: What is the structure of the chewing apparatus?

Material: X-rays of teeth, extracted teeth, a small mirror (better concave, 8 or 10-inch focus, for magnifying), a wooden toothpick.

Face a good light, open the mouth wide to let the light in, hold the mirror at the distance at which it will show the inside of the mouth most clearly.

Rub the tongue over the roof of the mouth.

1. *Is the front part or the back part of the palate bony?*

The uvula, hanging down as a curtain between the mouth and the pharynx, is the continuation of the soft palate.

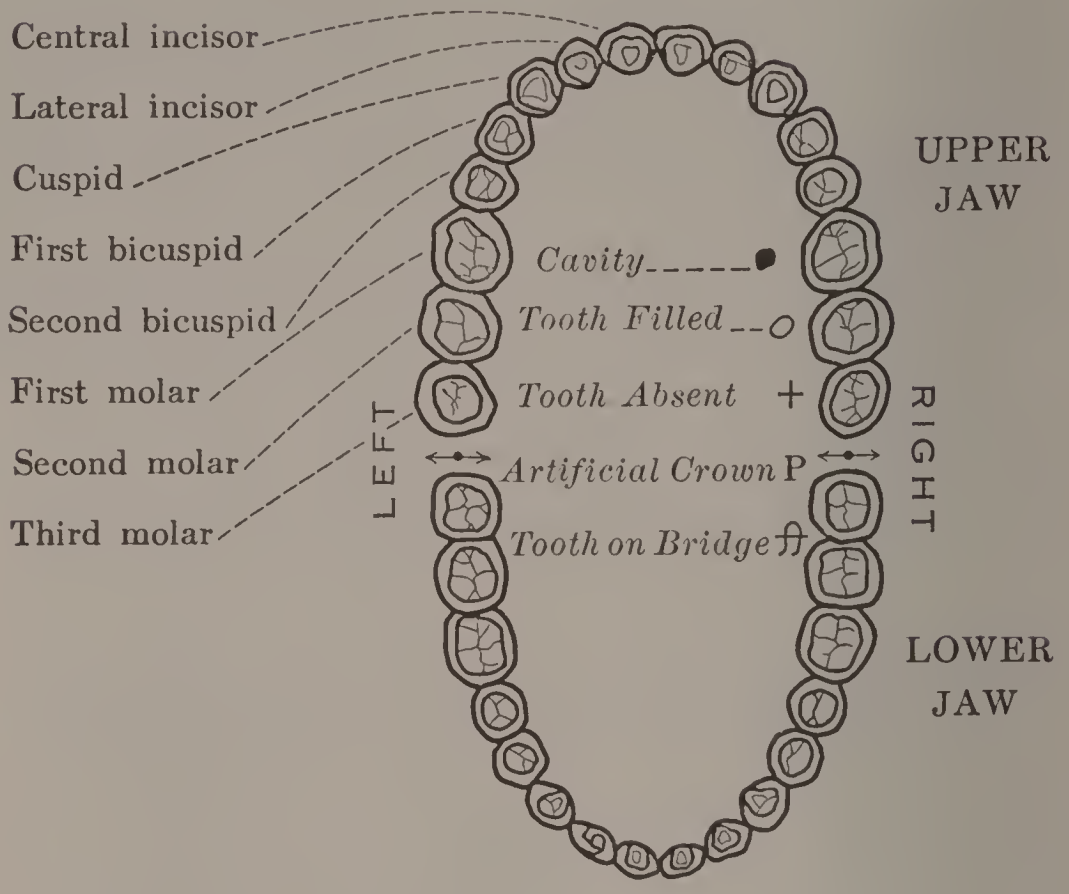
2. *Describe the movement of the uvula as you yawn.*

3. *Describe the mucous membrane lining the mouth,*
   (*a*) *its color,*

   (*b*) *its surface,*

   (*c*) *how it feels to the finger or tongue.*

4. *Cross off on this tooth chart any teeth you have not.*



5. *Distinguish in your mouth the front teeth from the back, and tell how the two groups differ from each other,*

(*a*) *in the shape of the teeth,*

(*b*) *in their use.*

6. *Name the front teeth.*

7. *Name the back teeth.*

8. *When the jaws close how do the front teeth meet?*

9. *How do the back teeth meet?*

10. *Explain how this meeting suits their function.*

11. *Put an extracted tooth into dilute hydrochloric acid and explain what the experiment indicates as to the composition of teeth.*

12. *Examining X-rays and extracted specimens, give the number of roots each kind of tooth has.*
Incisor, Cuspid, Bicuspid, Molar

13. *About how large are some abscesses (shown as dark spots in the X-ray) on the roots of some teeth?*

14. *In what situations are fillings and cavities most common?*

15. *With a toothpick find all the cavities in your teeth and mark them in the chart (page 52). Also chart the fillings and artificial crowns.*

16. *How does the upper surface of the tongue compare with its lower surface?*

17. *How does one variety of papilla on the tongue differ from another variety?*

18. *Find the openings of the salivary ducts (HEALTH, page 22) and describe their appearance.*

DIGESTION BY SALIVA

Problem: What effect has saliva on food?

Material: A little boiled starch, a test tube, a burner, Haynes solution, hydrochloric acid.

Put into the test tube about as much starch as a navy bean. Mix it with saliva from your own mouth. Shake the saliva and starch together. Test with Haynes solution (page 42).

1. *What does the result of the test indicate?*

Rinse out the tube and try again; this time, before putting in the Haynes solution, hold the tube in your hand five minutes to keep it warm.

2. *What difference from the first test do you notice?*

3. *Why is it well to chew starchy food a long time?*

Get one half inch or more of saliva in the test tube, put in three or four drops of hydrochloric acid, and shake it well. Now put in a little starch. Keep it warm a few minutes, then test for sugar.

4. *What effect does hydrochloric acid have on the work of saliva?*

5. *Why will not saliva continue to digest starch after it is mixed with gastric juice?*

THE WALLS OF THE STOMACH AND OF THE INTESTINE

Problem: How does the stomach wall compare with that of the intestine?

Material: A preserved piece of stomach wall and another of intestine; a hand lens.

Note that the piece of stomach can easily be split into two parts. One part is mucous membrane; the other is muscle with the serous membrane at the outside. The intestine is composed of the same three layers.

1. *Which layer in the stomach is noticeably thicker than the corresponding layer in the intestine?*

2. *What work of the stomach requires the greater thickness of this layer?*

3. *Describe the appearance of the villi of the intestine, when seen with the hand lens.* (*See* HEALTH, *pages 107 and 108.*)

4. *What sort of surface does the serous membrane give to the stomach and intestine?*

5. *Name as many uses as you can to which the serous membranes of slaughtered animals are put.*

AN INVENTORY

Problem: How can I record my practice in using food and in digestion?

In the table on page 60 under the word score write the date of record, one or two each week. After each item and under the score date mark 2, 1, or 0 as your practice is excellent, fair, or poor. Get the total. See to it that your record improves from week to week.

The teacher's purpose in asking you to make this inventory of yourself is to help you establish or confirm good habits in taking food and in caring for your digestive organs. The inventory leads you to see where you need to concentrate your attention to correct your faults. Whether you profit by the study, whether you improve your habits, depends on your own earnestness and perseverance.

FOOD AND DIGESTIVE HABITS

Items	Excellent (2)	Fair (1)	Poor (0)	Score			
Kinds of food	balanced ration, adapted to season and to needs	favorite dishes used too much, expensive	diet poorly balanced, harmful things used				
Quantity of food	enough for growth and activity	according to taste more than to need	markedly too little or too much				
Time of eating	at regular meal or set lunch only	meals regular, lunching irregular	munching at any time, candy, etc.				
Chewing	till food is well mixed with saliva and swallows easily	little, then forcibly swallowing	wash food down with drink				
Care of teeth	brushed, cleaned between, daily, no defects	brushed carelessly, irregularly, some cavities	not cleaned, decayed teeth neglected				
Bowel movement	at least once a day, easy	with difficulty, feces hard	badly constipated				
Clean hands at table	washed with soap, nails cleaned	quickly rinsed only, nails untidy	not washed, nails dirty				
			Total score				

THE STRUCTURE OF THE HEART

Problem: How does the blood-pump work?

Material: A sheep pluck and two seekers (HEALTH, page 113).

Arrange the heart and lungs ventral side up, the lobes of the lungs partly covering the heart. Note the auricles (little ears) at the anterior end or base of the heart, and the diagonal fat line which marks the boundary between right and left ventricles.

1. *Which chamber has thickest walls?*

2. *Why need it be so?*

3. *What two chambers have thin walls?*

4. *Why do they not need thicker walls?*

Explore the right auricle with a seeker and find the veins which enter it.

5. *Describe their size and thickness of wall.*

With a seeker follow the artery from the right ventricle.

6. *Where does it go?*

7. *Contrast the wall of this artery with that of the vein. (Try stretching it with your fingers.)*

Put your finger through the hole cut in the right auricle and find the natural opening into the ventricle.

8. *About how large is this opening?*

9. *Describe the valves which guard it.*

10. *Describe the semilunar valves shown in the cut in the right ventricle at the beginning of the pulmonary artery.*

With a seeker through the cut in the left auricle explore the veins entering it.

11. *From what organ do these veins come?*

With your finger through the hole cut in the left auricle find the opening from the auricle to the ventricle.

12. *How large is this opening?*

Pass a seeker through the cut in the left ventricle and out the aorta.

13. *What is the position of the aorta with reference to the pulmonary artery?*

With your finger trace in the diagram (HEALTH, page 113), the course of the blood through the heart and lungs.

14. *Starting at the right auricle name in order the vessels and chambers through which the blood passes.*

15. *Find the portion of the pericardium not cut away by the butcher and describe it, — thickness, surface.*

THE HEART BEAT

Problem: How fast does the heart beat, and what sounds does it make?

(*A*) The Pulse

Find your pulse in the wrist or neck by pressing gently with your fingers. Count the number of beats in one minute. Record in the first column the number for each member of the class.

Class Rate	
Normal	After Exercise
Total	
Average	

1. *What is your normal pulse rate?*

2. *What is the class average (first column)?*

Exercise for two minutes under the teacher's directions. Count the beat and make the class record in the second column.

3. *What is your rate after exercise?*

4. *What is the class average after exercise?*

5. *Which half minute after exercise was more rapid?*

6. *Why need there be this difference?*

7. *Are the beats steady like the ticking of a clock, or is there difference in the intervals and in the strength of the beats?*

8. *Get your pulse in as many places as you can and make a list of the places.*

(*B*) The Sound

Material: A magnifying stethoscope (Pollard).

Go with a co-worker to a quiet place, put your ear to his bare chest and listen to the heart beat. Again listen with the stethoscope.

1. *How many sounds do you hear for each pulse beat?*

Reproduce the sounds by knocking on the desk.

2. *Are the sounds equally spaced in time?*

3. *Listening in several places, where do you hear the sounds most plainly?*

4. *Explain how the sounds are produced.*

BREATHING AND VENTILATION

Problem: At what rate do we breathe, and how much air do we need?

Material: Spirometer, disinfecting fluid, rinsing water, watch with second hand.

Exhale five normal breaths into the spirometer and compute the average number of cubic inches to each breath.

Class Rate	
Normal	After Exercise
Total	
Average	

1. *How many cubic inches of air do you breathe at an average breath?*

Count the number of times your neighbor inhales in a minute. Record in the first column the numbers for all the members of the class.

2. *How many normal breaths do you take in a minute?*

3. *Compute the number of cubic feet you would breathe in an hour.*

4. *Give the dimensions of a box that would contain so many cubic feet.*

5. *How many cubic feet would the entire class use in an hour?*

Measure your schoolroom.

6. *If the air is changed three times an hour in ventilation how many times as much air is brought into the room as the pupils breathe?*

After exercising two minutes according to the teacher's directions count your neighbor's breathing again and make the class record in the second column.

7. *How is the number of breaths after exercise different from the number before?*

8. *Why need there be this difference?*

AIR HUMIDITY

Problem: How may we find the humidity of the air, and its effect on breathing?

Material: A wet and a dry bulb thermometer.

Fan both thermometers till they are as low as they will go, then read them. Subtract the reading of the wet bulb thermometer from that of the dry bulb instrument. In the table on page 69 look down the first column till you come to the number which is the dry bulb reading, then go across the table till you come to the column headed by the number which is the difference between the two thermometer readings. The number there found is the relative humidity of the air of the room, *i.e.*, a per cent obtained by dividing the number of grains of vapor there are in a cubic foot of air by the number there would be if the air were saturated, holding as much vapor as possible.

1. *What is the humidity of the room?*

Take the instrument out of doors in the shade, read it, and refer to the table.

2. *What is the humidity out of doors?*

3. *How does it come that the humidity out of doors is different from that within the room?*

Try moistening the air of the room in several ways — by exposing wet cloths, by boiling a dish of water, by throwing a fine spray from an atomizer, etc.

4. *If you notice any difference in the "feel" of the air after any of these experiments note it here.*

5. *Get the humidity of the air with the instrument after each experiment and state it here.*

6. *Which method of moistening the air is most effective?*

TABLE FOR FINDING RELATIVE HUMIDITY: PERCENTAGES

Dry Therm. (Air Temp.)	Difference Between Dry and Wet-Bulb Thermometers																											
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
0	68	35	3																											
2	71	41	12																											
4	73	46	19																											
6	75	50	25	1																										
8	77	54	31	9																										
10	79	57	36	15																										
12	80	60	41	21	3																									
14	82	63	45	27	10																									
16	83	66	49	33	16	0																								
18	84	68	53	38	22	7																								
20	85	70	56	42	28	14																								
22	86	72	59	45	32	19	7																							
24	87	74	61	49	36	24	12	0																						
26	88	75	64	52	40	29	18	7																						
28	88	77	66	55	44	33	23	12	2																					
30	89	78	68	57	47	37	27	17	8																					
32	90	79	69	60	50	41	31	22	13	4																				
34	90	81	72	62	53	44	35	27	18	9	1																			
36	91	82	73	65	56	48	39	31	23	14	6																			
38	91	83	75	67	59	51	43	35	27	19	12	4																		
40	92	84	76	68	61	53	46	38	31	23	16	9	2																	
42	92	85	77	70	62	55	48	41	34	28	21	14	7	0																
44	93	85	78	71	64	57	51	44	37	31	24	18	12	5																
46	93	86	79	72	65	59	53	46	40	34	28	22	16	10	4															
48	93	87	80	73	67	60	54	48	42	36	31	25	19	14	8	3														
50	93	87	81	74	68	62	56	50	44	39	33	28	22	17	12	7	2													
52	94	88	81	75	69	63	58	52	46	41	36	30	25	20	15	10	6	0												
54	94	88	82	76	70	65	59	54	48	43	38	33	28	23	18	14	9	5	0											
56	94	88	82	77	71	66	61	55	50	45	40	35	31	26	21	17	12	8	4											
58	94	89	83	77	72	67	62	57	52	47	42	38	33	28	24	20	15	11	7	3										
60	94	89	84	78	73	68	63	58	53	49	44	40	35	31	27	22	18	14	10	6	2									
62	94	89	84	79	74	69	64	60	55	50	46	41	37	33	29	25	21	17	13	9	6	2								
64	95	90	85	79	75	70	66	61	56	52	48	43	39	35	31	27	23	20	16	12	9	5	2							
66	95	90	85	80	76	71	66	62	58	53	49	45	41	37	33	29	26	22	18	15	11	8	5	1						
68	95	90	85	81	76	72	67	63	59	55	51	47	43	39	35	31	28	24	21	17	14	11	8	4	1					
70	95	90	86	81	77	72	68	64	60	56	52	48	44	40	37	33	30	26	23	20	17	13	10	7	4	1				
72	95	91	86	82	78	73	69	65	61	57	53	49	46	42	39	35	32	28	25	22	19	16	13	10	7	4	1			
74	95	91	86	82	78	74	70	66	62	58	54	51	47	44	40	37	34	30	27	24	21	18	15	12	9	7	4	1		
76	96	91	87	83	78	74	70	67	63	59	55	52	48	45	42	38	35	32	29	26	23	20	17	14	12	9	6	4	1	
78	96	91	87	83	79	75	71	67	64	60	57	53	50	46	43	40	37	34	31	28	25	22	19	16	14	11	9	6	4	1
80	96	91	87	83	79	76	72	68	64	61	57	54	51	47	44	41	38	35	32	29	27	24	21	18	16	13	11	8	6	4
82	96	91	87	83	79	76	72	69	65	62	58	55	52	49	46	43	40	37	34	31	28	25	23	20	18	15	13	10	8	6
84	96	92	88	84	80	77	73	70	66	63	59	56	53	50	47	44	41	38	35	32	30	27	25	22	20	17	15	12	10	8
86	96	92	88	84	80	77	73	70	66	63	60	57	54	51	48	45	42	39	37	34	31	29	26	24	21	19	17	14	12	10
88	96	92	88	85	81	78	74	71	67	64	61	58	55	52	49	46	43	41	38	35	33	30	28	25	23	21	18	16	14	12
90	96	92	88	85	81	78	74	71	68	64	61	58	56	53	50	47	44	42	39	37	34	32	29	27	24	22	20	18	16	14
92	96	92	89	85	82	78	75	72	69	65	62	59	57	54	51	48	45	43	40	38	35	33	30	28	26	24	22	19	17	15
94	96	92	89	85	82	78	75	72	69	66	63	60	57	54	52	49	46	44	41	39	36	34	32	29	27	25	23	21	19	17
96	96	93	89	86	82	79	76	73	70	67	64	61	58	55	53	50	47	45	42	40	37	35	33	31	29	26	24	22	20	18
98	96	93	89	86	82	79	76	73	70	67	64	61	58	56	53	51	48	46	43	41	39	36	34	32	30	28	26	24	22	20
100	96	93	90	86	83	80	77	74	71	68	65	62	59	57	54	52	49	47	44	42	40	37	35	33	31	29	27	25	23	21

THE MECHANISM OF BREATHING

Problem: What body movements cause the air to go into the lungs and out of the lungs?

Sit up straight and take deep breaths.

(*A*) Inhalation

1. *In what direction does the front of the chest move as you inhale?*

2. *What motion do you notice in the wall of the abdomen as you inhale?*

3. *Would this motion be caused by an upward or by a downward motion of the diaphragm?* (*Health, page 144.*)

4. *Would such motion of the diaphragm and of the chest wall make the chest larger or smaller?*

5. *Explain why the air goes into the chest.*

(*B*) Exhalation

1. *In what direction does the front of the chest move as you exhale?*

2. *Describe the movement of the walls of the abdomen when you expel the breath forcibly.*

3. *What effect on the diaphragm has this movement?*

4. *Would such movement of the diaphragm and of the chest walls make the chest larger or smaller?*

5. *Explain why the air goes out of the chest.*

A STUDY OF THE KIDNEY

Problem: By what structures is the kidney able to do its work?

Material: A pig's kidney sliced open, an entire kidney of a lamb, a hand lens.

(*A*) External Structure

1. *What kind of tissue is seen in large mass around the kidney nearly covering it?*

Loosen part of the covering.

2. *What sort of surface has the kidney?*

3. *Where is the hilum, the place where the attachments are not easily loosened?*

4. *In the diagram in* HEALTH, *page 31, what three tubes are shown joining the kidney at the hilum? Find them if you can in the specimen before you.*

(*B*) Internal Structure

1. *What is the color of the cortical layer, about one half inch or more thick, at the outside of the kidney?*

2. *What is the color of the medullary layer, composed of pyramids whose bases are in the cortical layer?*

3. *Describe the mucous membrane lining the pelvis of the kidney, the cavity which drains into the ureter.*

Examine a pyramid section with a lens.

4. *What is the appearance of the tubules of which the pyramid is composed?*

A STUDY OF THE SKIN

Problem: What structures of the skin adapt it to the work it does?

Material: A torn piece of leather, printer's ink roller, benzine, mirror, lens, hot water.

With the lens examine the *torn* edge of a piece of leather. (See HEALTH, page 153.)

1. *What reason have you for thinking that the leather is dermal rather than epidermal?*

With a pin pick up a bit of callus in the hand.

2. *What evidence have you that it is the epidermis which is thickened to form the callus?*

Touch the side of the end phalanx of each finger of one hand in succession to the ink roller, then roll the finger over across its face to the other side. Then impress the finger in the same way on this paper and lift it without sliding or rolling it back. To clean the fingers wipe them with a rag saturated with benzine (beware of fire), then wash them with soap.

First finger, Second finger, Third finger, Fourth finger

3. *In what particulars are the prints alike?*

4. *In what particulars are the prints different from one another?*

Examine a finger tip with the magnifier. If you see no tiny drops of sweat hold the finger in hot water for a few seconds, rub, and squeeze it — the sweat will probably appear.

5. *Are the sweat pores in the ridges, or in the grooves of the palmar surface?*

6. *Where can you find inconspicuous hairs in the skin?*

7. *Where can you find no hairs at all?*

8. *Make a sketch of the back of the finger showing the nail and indicating the three areas of the nail.*

Squeeze the tip of the nose between the thumb and finger, observing in a mirror. Absorb the expressed secretion on a piece of paper.

9. *Is the expressed secretion oil or sweat?*

SKIN AND FEET SCORE

In the score column write for each item 2, 1, or 0 as its condition is excellent, fair, or poor. Make another score some weeks later to see how much better it will be.

Items	Excellent (2)	Fair (1)	Poor (0)	Score
Finger nails	smooth, regular, even with the flesh	ragged and uneven, fairly serviceable	bitten or torn, too short for use	
Corns and bunions	none	a few, not troublesome	so bad as to interfere with comfort	
Warts	none	a few, not troublesome	many, painful or in the way	
Fimples	none	few, small	many, skin inflamed	
Stockings	so large as to allow freedom to the toes, thick in foot	pinch toes a little, too thin	uncomfortably press toes, bend them under	
Shoes	fit according to soldiers' rule, heels low and broad, toes wide	narrow, tire feet, heels moderate	too short, distressingly narrow or cramp toes, heels high	
Bathing	daily, or two or three a week	weekly	irregular and infrequent	
			Total	

SCORE IN EXERCISE AND POSTURE

Make a check mark opposite each item that has been satisfactorily carried out during the week preceding the date at the head of the column. Mark a 0 if the item has not been properly done. Or mark a per cent grade expressing the degree of excellence of your practice.

ITEMS DATES								
Daily exercise an hour in fresh air								
At least part of the exercise so vigorous as to produce sweat								
No exercise carried to the point of exhaustion								
Rhythmic body movements in room 15 minutes daily, in fresh air								
Play in games, — inter-school, inter-class, etc.								
Habitually sit erect. (HEALTH, page 181)								
Habitually stand erect, chest up, abdomen back. (HEALTH, pages 180, 183)								

A STUDY OF JOINTS

Problem: How do bones fit together at joints, and what movements do they have?

Material: Dry bones making joints, fresh joints sawed open.

1. *Give an example of a fixed joint, two bones immovably fastened together.*

2. *In the fresh specimen, what lies between the two bones of the fixed joint?*

3. *In a dry specimen, describe the contact surfaces of the bones of a fixed joint.*

4. *Observing a dry specimen, is the surface of a bone where it rubs against another at a movable joint smooth or rough?*

5. *Observing a fresh specimen, describe the cartilage covering the end of a bone at a movable joint, — color, thickness, firmness.*

6. *What is the color of the ligament which binds two bones together?*

7. *When you pull on a ligament does it stretch like rubber?*

8. *What sort of surface has the synovial membrane lining the joint cavity?*

9. *Describe the synovial fluid which lubricates the joint, — its color and "feel."*

10. *In what bone is the socket of the hip joint?*

11. *In what bone is the ball of the hip joint?*

Stand; move the leg at the hip as freely as you can.

12. *In what directions can a ball and socket joint move?*

13. *Name another joint which seems to have the same free movement.*

14. *If in the skeleton you find it to be a ball and socket joint,*
    (*a*) *name the bone which has the socket.*

    (*b*) *name the bone which has the ball.*

15. *In what directions can the knee joint move?*

16. *Name another joint which also has a hinge form.*

Move the jaw from side to side. This is a sliding or gliding joint.

17. *What would lead you to think that the wrist is also a gliding joint?*

Observe in the skeleton a pivot joint, the first vertebra with the second.

18. *What movement of the head does a pivot joint allow?*

THE BRAIN

Problem: What is the structure of the brain, its parts and tissues?

Material: A sheep's head sawed in two lengthwise, a model of the human brain, preserved specimens of brain, a dry skull with *dura mater* (the membrane enclosing the brain) in place.

1. *What color is the medulla, the continuation of the spinal cord, seen at the large opening at the base of the skull?*

2. *How does the medulla feel to your touch?*

3. *In what part of the cranial cavity does the axis of the brain extending forward from the medulla lie?*

4. *What color and how thick is the pillar or stem which fastens the cerebellum (just above the medulla) to the axis of the brain?*

5. *Sketch a lobe of the cerebellum (prepared slice) to show the arrangement of the two colors, gray and white.*

6. *In what part of the cranial cavity does the cerebrum, the large remaining portion of the brain, lie?*

7. *Sketch a portion of a lobe (preserved slice) of the cerebrum to show the arrangement of the gray and the white matter.*

8. *Which of these tissues (white or gray) is greater because of the convolutions (folds) than it would be if the surface of the brain were smooth?*

To see the nerves, lift the brain *partly* out of its setting, being careful not to break these white cords.

9. *To what part of the brain are the nerves attached?*

10. *Describe the dura mater, the outer covering of the brain, which adheres to the skull when the brain is lifted out. (See the dry skull also.)*

11. *Describe the inner membrane, which adheres to the brain.*

THE SPINAL CORD

Problem: What are the setting and the structure of the spinal cord?

Material: A piece of the vertebral column containing a portion of the cord, dry vertebrae or skeleton, microscopic slide of a cross section of the cord stained, a hand lens, a microscope.

1. *Compare the membranes covering the cord (meninges) with those of the brain.*

2. *Describe the "feel" of the fresh cord.*

3. *Where do the nerves from the cord pass out of the spinal canal? (Examine the skeleton as well as the fresh material.)*

4. *Sketch a cross section of the cord seen under the lens, to show the arrangement of the gray and the white matter and the meninges.*

5. *Sketch in cross section a half dozen axons from the white matter, seen under the compound microscope.*

THE EYE

Problem: What can we learn about the structure, working, and care of the eyes?

Material: A vision chart, a mirror, an animal's eye (HEALTH, page 233).

1. *Observing your eye in a mirror, sketch what you see and label the white, the iris, and the pupil.*

2. *Looking at your neighbor's eye from the side do you see the cornea more curved, or less curved than the remainder of the eye?*

3. *In what part of each lid do you feel a thick strip of connective tissue?*

At the angle in the lower lid, about a quarter of an inch from the inner corner, is the opening of a small duct which carries the water from the eye into the nose.

4. *About how large is the opening of this tear duct?*

Hold a bright light above and in front of your neighbor's face, shading the direct light from his eyes with your hand. While you are watching the iris remove your hand and let the light shine into his eyes.

5. *What change in the size of the pupil does the light make?*

Hold your pencil at several different distances from your eyes.

6. *At what distance can you see the point most comfortably and clearly?*

From this distance move the pencil slowly toward the eye.

7. *At what distance from the eye does it become indistinct or fringed with haze?*

Stand on a line twenty feet from the vision chart. Hold a card in front of the left eye, so that while both eyes are open you can see the chart with the right eye only. If you commonly wear glasses, use them. Read the letters, beginning at the top.

8. *Can you read correctly the majority of the letters of the twenty-foot line?*

Test the left eye, holding the card before the right.

9. *Can you read the twenty-foot line?*

10. *What practical suggestion do you make for those whose eyes are not up to the normal task of reading this line?*

Practice turning the upper lid of your neighbor's eye as you would turn it for removing a cinder, thus: Take hold of the lashes of the upper lid with the thumb and finger of your left hand and pull it gently forward. At the same time press lightly down in the middle of the lid with a pencil or match, turning it inside out. (The muscles of the lid must be relaxed.) Draw a wisp of sterile cotton across the eye, wiping out the cinder.

11. *Describe the conjunctiva which you see lining the lid and folding back over the eyeball.*

12. *Describe each of the following seen in the animal's eye which has been cut open with a sharp knife:*

(*a*) *the aqueous humor, which escapes when the front of the eye is cut open,*

(*b*) *the vitreous humor, occupying the center of the eye,*

(*c*) *the cornea,*

(*d*) *the iris,*

(*e*) *the retina,*

(*f*) *the hard (sclerotic) coat.*

13. *What makes the pupil of the eye look black?*

CONFECTIONARY STORE SCORE

Problem: Are the candy stores patronized by the pupils reasonably sanitary?

Visit a store, watch its condition and attendants for half an hour, then mark your score. Try the same store some other hour or day and see if you get the same score.

PLACE..... .....DATE

Items	Excellent (2)	Tolerable (1)	Intolerable (0)	Score
Tables and utensils	tidy and scrupulously clean	fairly clean	dirty and mussy	
Attendants, personal	hands clean and well manicured, clothing spotless	hands washed occasionally, nails not neat, clothing spotted	dirty and sloppy, put fingers in mouth, clothes smeared	
Foods and drinks	rarely touched by hands, kept covered, no flies	handled unnecessarily, not covered	handled and mussed, many flies	
Dish washing	washed in hot suds rinsed in running water, or paper dishes once used	washed in hot water, rinsed in basin fairly clean	rinsed in dirty water	
			Total	

APPLYING DRESSINGS AND BANDAGES

Problem: How may we become skillful in rendering first aid and in dressing small injuries?

Material: A supply of bandages of different sizes and kinds, gauze, cotton, iodin.

(*A*) General

1. Use the bandage rolled. (Convenient bandages can be bought in the common sizes ready rolled and sterile.) To roll a bandage, lay the strip along the thigh, fold the end a few times over for a start, then run the hand down the thigh, rolling the bandage under it. Draw the roll up to the hip, bringing more of the strip on to the thigh and pulling the roll tight. Run the hand down the thigh again with the roll under it. Repeat. Fasten the end of the roll with a pin.

Try bandaging the arm with a rolled bandage and then with a strip not rolled, and write here the particulars in which the roll is better.

2. Start the bandage right side out, with the outside of the strip against the skin, and keep it so unless it is necessary to reverse.

Try the bandage with the inside of the strip next the skin and point out how the right way is superior.

3. If the skin is very dirty wash around, not in, the wound with warm, soapy water, using gauze or cotton for a sponge.

Why not wash in the wound?

4. Apply iodin with an applicator (a small stick with a wisp of cotton twisted around one end) to the skin around the wound.

Why is the iodin applied?

5. Lay a piece of sterile gauze over the wound, taking it by the corner so as not to contaminate the surface that touches the wound. (Gauze can be bought in sterile rolls. Snip off with shears as much as you need, being careful not to contaminate the gauze with the fingers.)

If you have no roll of gauze how can you sterilize a piece of cheesecloth or muslin to use for a pad?

6. Put on a bandage over the gauze as directed in the following section.

What is the function of the bandage?

(*B*) Applying the Bandage

The bandage must be so snug as to hold the pad in place, but not so tight as to interfere with the circulation.

1. On the Arm ; a bandage one and one half inches wide. Take the bandage roll in your right hand ; hold the end (right side out) against the wrist of the arm to be bandaged ; place the thumb of your left hand on this end while you roll the bandage around the wrist and over the end. This anchors the end.

Continue rolling the bandage around the arm and over the pad, passing it from one hand to the

other. The tapering form of the arm will cause the bandage to climb up toward the elbow as it goes around. When the roll is near the elbow put a finger or the thumb of your left hand on the bandage and turn the roll over (inside out) and wind it down

toward the hand. At the wrist reverse the roll (to right side out) and wind up the arm. When the end of the bandage is reached fasten it with a safety pin or split the end and tie it around the arm.

What keeps the bandage from slipping down the tapering arm?

2. Across the Bent Elbow; a bandage one and one half or two inches wide.

This application is called a figure of eight. Use a large gauze pad over the elbow. Take one turn of the bandage around the arm below the elbow to secure the end, and another to hold the pad. At the next round cross over to the upper arm at the inside of the elbow and make a turn around it, securing the other end of the pad. At the inside of the elbow cross back to the fore arm, around it, and back to the upper arm. So to the end of the bandage.

Where else would you use the figure of eight bandage?

3. Covering the Finger Tip; a three fourths or one inch bandage.

Take two turns around the finger near the base to anchor the end of the bandage. Place your left thumb on the bandage, turn at a right angle and loop the bandage over the finger tip and down the other side. Make a loop here over a finger of your left hand and bring the roll back over the tip of the bandaged finger to your thumb. Turn at a right angle and go around the finger, spiraling up to the tip and back to the base of the finger. Cross the back of the hand to the wrist, twice around and fasten.

Why does it matter whether the roll is passed in a right-hand or a left-hand turn around the finger?

4. To Cover the Hand; a one and one half inch bandage.

Take two turns around the wrist for anchorage. At the next turn slant up across the back of the hand and go twice around it above the thumb. Then down across the back of the hand and around the wrist. Again slant up across the back of the hand, twice around, down to the wrist, twice around, fasten.

Why does it make a difference in convenience of applying the bandage whether you start it in a right-hand turn or a left-hand turn?

5. A Head Bandage, — Cross Circles; a strip two inches wide, not rolled.

Place the middle of the bandage against the forehead and pass one end horizontally around the head to meet the other at the temple. Tie a single knot. Pass the longer end under the chin and up the other side to meet the shorter end at the top of the head. Tie; or if the strips are long enough cross them at the top of the head, pass them under the chin and to the top of the head, tie.

Name the various places at which a pad covering a wound would be held secure by this bandage.

5*a*. Another way of applying a head bandage of similar form.

Place the middle of the strip under the chin, bring the ends above the head, and tie in a single knot.

Let the patient hold the ends of the strip lightly with arms extended at the sides of the head,

slacking while the operator divides the knot, pulling one strand with one hand to the forehead and the other strand with the other hand to the back of the head, leaving the strands crossed at the temples. Tie the ends at the top of the head.

In what way is this more secure than 5? Under what circumstances could 5 be used when 5a could not?

6. The Four-tailed Bandage; a strip of muslin a yard long and four or six inches wide, split from each end to within four inches of the center.

To bind the jaw, place the center of the bandage on the chin. Tie the upper pair of tails behind the head. Then cross the lower pair of tails to the top of the head, and tie. Tie the upper and the lower ends together.

In what directions does this draw the jaw? What other convenient application of this bandage can you find?

7. The Triangular Bandage; a square yard of gauze folded diagonally, or a square yard of muslin cut diagonally to make two bandages.

This bandage has a variety of uses. Fold the right angle to the diagonal side, then fold again and again parallel to the first fold. This makes a strip thick in the middle and thin at the ends. It can be tied around the head horizontally to cover the forehead, or lower to cover the eyes, or diagonally to cover one eye, or passed under the chin and tied at the top of the head. It is convenient to wrap and tie around the arm or leg.

To make an arm sling spread the bandage out, place the elbow on the right angle, the inner end over the far shoulder, the outer end over the near shoulder, and tie at the back of the neck. (A straight, broad bandage is also used for a sling.)

What other uses do you find convenient for the triangular bandage?

8. Adhesive Tape.

When a bandage is undesirable, a pad covering a wound or sore can be held in place by adhesive tape. The tape is not put directly on the cut or sore, but over the pad. Even a small cut should have a piece of gauze over it. The skin must be dry where the tape adheres to it. If hairy, like the back of the hand, the skin should be shaved where the tape adheres. A single strip of tape is adequate for a small pad, but for a large spot two pieces of tape should be used crossing over the pad.

Tape is convenient also for securing a bandage which is likely to slip, and for fastening the end of a bandage. The doctor commonly uses a tape bandage wrapped around a sprained joint to keep it stiff.

Name any other uses for adhesive tape in dressings.